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III.

A CONTRIBUTION TO OUR KNOWLEDGE OF PALEOZOIC ARACHNIDA.

By Samuel H. Scudder.

Communicated June 11th, 1884.

Until a very recent period discoveries of fossil Arachnida in the older rocks had been exceedingly few, and the first and only attempt to show their relations to each other and to living forms was made in a recent paper by Karsch,[*] occasioned by his description of a new generic type. Yet the first discovery of carboniferous forms dates back to Corda, who described [†] a scorpion found by Sternberg at Chomle in Bohemia, a discovery which justly awakened at the time the widest interest.

Karsch, in his brief attempt to bring into connected order the discoveries of the past, has established for the bulk of the species which do not belong to the scorpions the order Anthracomarti, divided into two families, the Architarboidæ and Eophrynoidæ.

The following is a succinct account of his arrangement: —

Order 1. ARANEÆ.

Body composed of two principal masses, of which the front (cephalothorax) is unsegmented, and the hinder (abdomen), unsegmented beneath, has at the most a single segmented dorsal plate.

Fam. LIPHISTIOIDÆ Thor.

Abdomen with segmented dorsum.

Protolycosa anthracophila Roemer (Silesia).

Order 2. OPILIONES.

Body forming either a single mass or two segment-complexes, always separated into segments both above and below.

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[*] Zeitschr. deutsch. geol. Gesellsch., 1882, p. 556.

[†] Verhandl. Gesellsch. vaterl. Mus. Böhmen, 1835, p. 35.

Fam. TROGULOIDÆ.

Dorsal segments of the abdomen each with three transverse fields. Palpi and mandibles not visible from above.

Kreischeria Wiedei Geinitz (Saxony).

ORDER 3. ANTHRACOMARTI Karsch.

Body composed of two main divisions, of which the front one is unsegmented, the hinder segmented. Palpi visible from above.

Fam. ARCHITARBOIDÆ Karsch.

Number of abdominal segments equal above and below. Integument smooth.

ARCHITARBUS Scudder.

Cephalothorax and abdomen not separated by a lateral constriction.

A. rotundatus Scudder (Illinois), *A. subovalis* Woodward (England), *A. silesiacus* Roemer (Silesia).

ANTHRACOMARTUS Karsch.

Cephalothorax and abdomen distinctly separated by a lateral constriction.

A. Völkelianus Karsch (Silesia).

Fam. EOPHRYNOIDÆ Karsch.

Number of dorsal and ventral segments of the abdomen unequal, more numerous above. Integument tuberculate.

Eophrynus Prestvicii (Buckl.) Woodward (England).

ORDER 4. SCORPIONES.

Body separated into three main divisions, the cephalothorax unsegmented, the abdomen segmented and furnished with a segmented tail-appendage (postabdomen).

Eoscorpius anglicus Woodward (England), *E. carbonarius* Meek and Worthen (Illinois), *Microlabis Sternbergi* Corda (Bohemia), *Cyclophthalmus senior* Corda (Bohemia), *Mazonia Woodiana* Meek and Worthen (Illinois).

While justified in the main in this arrangement, Karsch's definitions of the groups are both insufficient, and to some extent based on altogether subordinate characteristics. The discovery of new American forms enables me to supplement, and, as I believe, to improve these, and accordingly the following systematic sketch of paleozoic Arachnida has been prepared, into which have been thrown such suggestions and new facts as have come to hand.

ORDER ANTHRACOMARTI Karsch.

Body more or less depressed, the cephalothorax and abdomen distinctly separable. Cephalothorax frequently made up in large part of pedigerous segments more or less wedge-shaped, and visible above as well as below, the arrangement of which corresponds to that of the coxæ. The abdomen forms a single mass, and is composed of a variable number of visible segments, ranging from four to nine. Palpi not much longer than the legs, simply terminated.

Fam. ARTHROLYCOSIDÆ Harger.

Cephalothorax orbicular, twice as large as the abdomen. Coxæ radiating from a central pit. Abdomen oval, much narrower at base than the cephalothorax, with no longitudinal sculpturing, and composed of seven segments. No abdominal appendages.

ARTHROLYCOSA Harger.

Arthrolycosa antiqua Harger, Amer. Journ. Sc. Arts, (3,) vii. 219–223 (fig.), 1874. Mazon Creek, Illinois.

In his description of this arachnid, Harger inclines to the belief that the terminal segment of the palpus is chelate. He says (*loc. cit.*): "The third [joint] is broken near its proximal articulation, and the connection of this appendage with what seems to be its distal cheliform segment is unfortunately imperfect. This segment is also poorly preserved, and the articulation of its digit is only to be seen with a good magnifier and in a certain light. . . . I do not, however, consider the forcipulate character of this segment beyond a doubt. It is perhaps not improbable that it may have been modified much as in the males of ordinary spiders, and not truly forcipulate."

Having reason, by its undoubted relationship to other forms of Anthracomarti, to doubt the forcipulate character of the palpus, of which Harger speaks so doubtfully, Professor Marsh kindly permitted me to study the type in Yale College Museum, and I find on close examination that not only is the joint in question not chelate, but it terminates by a straight, transverse suture, and is followed by a portion of another, apparently short, terminal joint.

Fam. POLIOCHERIDÆ nov. fam.

Cephalothorax quadrate, not much smaller than the abdomen. Coxæ radiating (apparently) from a median line. Abdomen rounded, of equal breadth with the cephalothorax, with very indistinct or no longitudinal sculpturing, and composed of only four segments, of which the basal is very short. No abdominal appendages.

POLIOCHERA nov. gen.

Cephalothorax scarcely longer than broad, slightly narrowing anteriorly, the front square. Legs stout, moderately long. Abdomen full, at base as broad as the cephalothorax, broadening slightly behind, fully rounded, the first segment about one third the length of the others, which are equal.

Poliochera punctulata nov. sp. Body minutely, deeply and uniformly punctate throughout, excepting on the narrow first abdominal segment, which is smooth. Legs similarly punctate. Length 15 mm., greatest breadth 7.5 mm. Mazon Creek, Illinois (R. D. Lacoe, No. 1845). A fuller description and figure will be given at another time.

Fam. ARCHITARBOIDÆ Karsch.

Cephalothorax of variable form, but at least half as large as the abdomen. Coxæ radiating from a middle point or line, or from a triangular sternal piece, its base on the abdominal margin. Abdomen orbicular or oval, at base as broad or nearly as broad as the cephalothorax, with a lateral ridge on each side converging toward the anus, the surface moderately smooth; segments seven to nine in number, the basal ones visible below, though often extremely shortened in the middle; no abdominal appendages.

GERAPHRYNUS nov. gen.

Cephalothorax fusiform, angulated in front, nearly as large as the abdomen. Coxæ radiating from a median line. Palpi slenderer than the legs, longer than the cephalothorax, springing from its extreme front and of uniform size throughout. Abdomen subfusiform, composed of nine segments, rounded behind, with no constriction at the base; a large triangular post-thoracic plate, crowding the middle of the first five short segments out of a straight transverse line. Readily distinguished from Architarbus by its produced and angulate cephalothorax.

Geraphrynus carbonarius **nov. sp.** Cephalothorax faintly punctulate, its posterior portion and the post-thoracic plate more distinctly, while the abdomen is profusely and rather sparingly punctate. Length 20 mm. Greatest breadth 10 mm. Mazon Creek, Ill. (Coll. R. D. Lacoe, No. 1701.) A fuller description and figure will be given at another time.

The specimen is interesting as preserving very completely the left palpus.

ARCHITARBUS Scudder.

Cephalothorax orbicular, broadly rounded in front, much smaller than the abdomen, but not separated from it by a marked lateral constriction. Coxæ radiating from a central pit. Abdomen oval, composed of nine segments, of which those on the basal half are very much shorter than the others, and on the dorsal surface are forced still more closely together by the large post-thoracic plate.

Architarbus rotundatus Scudder, Worth. Geol. Ill., iii. 568, fig. 4, 1868. Mazon Creek, Ill.

Architarbus subovalis Woodward, Geol. Mag., ix. 385–387, pl. 9, fig. 1^a, 1^b, 1872. Lancashire, England. Here probably belongs *Curculioides Ansticii* Buckl. Geol., ii. 76, pl. $46''$, fig. 1, 1837. Coalbrookdale, England.

Architarbus silesiacus Roemer, Jahresb. schles. Gesellsch. vaterl. Cult., lvi. 54, 55, 1879. Glatz, Silesia.

ANTHRACOMARTUS Karsch.

Cephalothorax quadrate, the front square or scarcely convex, about half the size of the abdomen ; coxæ radiating from a broad triangular sternal plate, the base of which forms the posterior margin. Sides of the body constricted so as to show a distinct though generally slight separation of cephalothorax and abdomen. Abdomen orbicular, composed of seven segments of similar length throughout.

Anthracomartus Völkelianus Karsch, Zeitschr. deutsch. geol. Gesellsch., 1882, pp. 556–561, pl. 21, figs. 1, 2. Neurode, Silesia.

Anthracomartus Krejčii Kušta, Sitzungsb. böhm. Gesellsch. Wiss., October 12, 1883, pl., figs. 1–3, 1883. Rakonitz, Bohemia.

Anthracomartus trilobitus nov. sp. Sides of the cephalothorax angulated in the middle of the posterior half, behind which it narrows rapidly, showing a very marked constriction between it and the abdomen. The latter of equal length and width, broadest behind the middle, and furnished with a marginal flange nearly as broad as the lateral fields. Whole body delicately and uniformly punctate. Length 17.5 mm.; greatest width 11.25 mm. Fayetteville, Ark.

This interesting species was found in some abundance by Rev. F. S. Harvey in the subconglomerate coal measures about six miles northeast of Fayetteville. It differs from all the other species in the remarkable posterior narrowing of the cephalothorax. A fuller description and figure will be given at another time.

Anthracomartus pustulatus nov. sp. Cephalothorax narrowing somewhat forward. Abdomen longer than broad, oval, broadest in the middle, the longitudinal ridges converging regularly and considerably in straight lines, the whole surface of body closely covered with very irregularly polygonal sunken cells, giving the whole body a pustulate appearance. Length 15 mm.; greatest breadth 7.5 mm. Mazon Creek, Ill.

This species was received from Mr. R. D. Lacoe (No. 1752), and differs conspicuously in its rough surface structure from all other species. A fuller description is deferred.

Fam. EOPHRYNOIDÆ Karsch.

Cephalothorax quadrate, narrowing strongly in front, or triangular, less than one third the size of the full abdomen, broken dorsally into many plates. Coxæ radiating from a median furrow. Abdomen ovate orbicular, much broader than the cephalothorax, from which it is separated laterally by a distinct constriction; segments nine or ten in number, some of the basal segments obscured below, the dorsal plates either broken by irregular longitudinal sutures into one median and two lateral fields, or furnished with many longitudinal series of stout tubercles, or both; the penultimate and antepenultimate segments bearing lateral terminal spines.

KREISCHERIA Geinitz.

Cephalothorax subquadrate, with three large median plates, one in front and two behind, and on each side three smaller lateral plates. Dorsum of abdomen broken by oblique sutures, crossing each segment laterally subparallel to the lateral margin, into a median and lateral fields, of which the median is about as large as the combined lateral fields.

Kreischeria Wiedei Geinitz, Zeitschr. deutsch. geol. Gesellsch., 1882, pp. 238–242, pl. 14, figs 1, 2. Zwickau, Saxony.

This species was referred correctly by Geinitz to the vicinity of Eophrynus, but by Karsch considered as belonging to the Opiliones in the neighborhood of Trogulus. The structure of the cephalothorax, though very different in general appearance from that of Eophrynus, is essentially identical with it, and the abdomen only differs in essential points from that of Eophrynus in characters which ally it to the Architarboidæ.

EOPHRYNUS Woodward.

Cephalothorax triangular; its dorsal surface tumid, completely broken into great tuberculate bosses, arranged in a lateral row down either side and a median row dividing in two at the posterior margin. Dorsal surface of abdomen with two lateral rows of large rounded tubercles and a median row of large stellate tubercles, besides being sometimes divided by longitudinal sutures into median and lateral fields.

Eophrynus Prestvicii Woodward, Geol. Mag., viii. 385–387, pl. 11, figs. 1, 2, 1871. *Curculioides Prestvicii* Buckland, Geol., ii. 76, 77, pl. 46″, fig. 2, 1837. Coalbrookdale and Dudley, England.

The discovery of new remains of this curious arachnid led Mr. Woodward to notice the incorrect reference of similar remains by Buckland and Samouelle to the Coleoptera. As stated above, it seems probable that the other species referred in the same place to the Coleoptera will prove to be an Architarbus. Woodward neither figures nor makes mention of any fracture of the dorsal plates in his very excellently preserved specimen; but as this exists in the next species, it would seem probable that they might have been overlooked.

Eophrynus Salmi Stur, Abhandl. geol. Reichsanst., viii. ii, p. v, note (fig.), 1877. Ostrau, Moravia.

The generic name is incorrectly spelled Euphrynus.

ORDER PEDIPALPI Latreille.

GERALINURA nov. gen.

Cephalothorax ovate, the front rounded, one third as broad as hinder portion. Palpi large and robust, with interior spines. First two pairs of legs slender, the hinder stout and broad. Abdomen composed of nine joints, the basal three rather short, the others subequal and longer. Postabdomen much as in Thelyphonus.

Geralinura carbonaria nov. sp. Hinder legs three times as stout as the front pairs, the fourth much longer than the third. Abdomen about twice as long as broad. Postabdomen composed first of two joints together half as long as broad, one third as broad as the abdomen, next of a single quadrate joint, followed by the thread, about one fourth or one fifth as broad, of unknown length, with numerous joints about twice as long as broad. Length to end of abdomen proper, 13.5 mm. Mazon Creek, Ill. (R. D. Lacoe, No. 1754.) Fuller description deferred.

The discovery of this fossil is one of the most interesting in this field in recent years, as it is the first of the Pedipalpi yet found in paleozoic rocks, or perhaps in any deposits, and it differs from modern types no more than do the carboniferous scorpions. It was brought to my notice after the rest of this paper was in type.

ORDER SCORPIONES Thorell.

In his paper in the Transactions of the Royal Society of Edinburgh, where he added so much to our knowledge of fossil scorpions, Mr. B. P. Peach remarks that, "although there seems to be sufficient reason to separate the genus [Eoscorpius] from any recent one, these ancient scorpions appear not to differ in any essential character from those now living"; and Dr. A. Geikie, in commenting on Mr. Peach's discoveries in "Nature" (vol. xxv. pp. 1–3), says, "It is obvious that the scorpion has remained with hardly any change since carboniferous times." Geikie also notices that "the chief difference between the living scorpion and its ancient progenitors lies in the fact that in the fossil forms the mesial eyes are much larger in proportion to the lateral ones, and also to the size of the whole animal."

There are, however, some points in the structure of these paleozoic forms which show that they differ from modern types more than the above statements would appear to warrant. In the only one of Mr. Peach's figured specimens showing clearly the under surface of the cephalothorax, we find that the coxæ of the second pair of legs do not touch along the middle line of the body, as in all living forms, (where they cut off anteriorly the so-called sternum,) but are separated by a pair of independent plates — the sternites apparently of the second thoracic segments — which lie in advance of the sternum proper.

In addition to this, the structure of the comb, upon which in part the families of living scorpions are based, differ remarkably from all recent forms, if we are to judge solely by the information Mr. Peach has given us. In all living types the combs are made up (1st) of a variable number of longitudinally disposed lamellæ. These form an anterior row, composed of two or three (generally three) plates, the basal much the larger; a posterior row of numerous minute rounded scales, and an intermediate series more or less numerous, disposed in from one to three longitudinal rows, of which the basal ones are the larger, and the others generally larger than those of the posterior row, excepting when there is more than one intermediate series. (2d.) Besides these, there is a single marginal row of processes, the teeth of the comb, which are as numerous as the scales of the posterior row to which they correspond.

To judge from Mr. Peach's figures and descriptions, the anterior row, which in modern scorpions forms the backbone of the comb, and is mostly made up of a single plate very broad at base, is just as weak in structure as the intermediate lamellæ, which are also excessively reduced and multiplied; or perhaps the anterior row is entirely wanting, and its place occupied by a vegetative development of the "intermediate" series, a view which might be re-enforced from what is known of Meek and Worthen's species. The teeth also in one of Mr. Peach's examples are represented apically by a "double row of leaflets, which overlap in an imbricating manner like tiles." On the other hand, the figure which Fritsch has given us of Corda's Bohemian species resembles modern types much more closely except in the entire absence of the intermediate series, throwing some doubt upon the constancy of the characters apparently derivable from the other sources.

The differences which exist should certainly not be ignored, and it may lead to an earlier decision of the question whether distinctions any broader than mere generic ones may separate the earlier from the modern forms, if we place these paleozoic forms in a distinct family, and endeavor to define their characteristics. This we propose doing under the following provisional characters.

EOSCORPIONIDÆ nov. fam.

A pair of sternal plates interposed visibly between the coxæ of the second pair of legs. Posterior sternal plates, corresponding to the "sternum" of living scorpions, quadrate, large, of about equal length and breadth. Both intermediate and dorsal lamellæ of the combs very numerous, rounded and small, subequal, and not larger than the fulcra, arranged in many rows, the teeth numerous and forming a single row toward the base of the comb, but a double imbricated row apically. Hands slender. Mesial eyes very large and elevated. Five lateral eyes of equal size on each side, forming a single continuous semicircle around and behind the mesial eyes.

EOSCORPIUS Meek and Worthen.

Eoscorpius carbonarius Meek and Worthen, Geol. Ill., iii. 560–562, fig., 1868. *Buthus? carbonarius* Ibid., Amer. Journ. Sc. Arts, (2,) xlvi. 22–24, 1868. Mazon Creek, Ill.

Eoscorpius anglicus Woodward, Quart. Journ. Geol. Soc. Lond.. 1876, p. 58, pl. 8, figs. 2–3, 3^a, 5. Mansfield, England.

Eoscorpius euglyptus Peach, Trans. Royal Soc. Edinb., xxx. 402–404, pl. 22, figs. 3–3^d, 1882. River Esk, Scotland.

Eoscorpius glaber Peach, Trans. Roy. Soc. Edinb., xxx. 400–402, pl. 22, figs. 2–2^1, 1882. Scotland.

Eoscorpius inflatus Peach, Trans. Roy. Soc. Edinb., xxx. 405, 406, pl. 23, figs. 12–12^d, 1882. River Esk, Scotland.

Eoscorpius tuberculatus Peach, Trans. Roy. Soc. Edinb., xxx. 398–400, pl. 23, figs. 8–8^h, 1882. Scotland.

CYCLOPHTHALMUS Corda.

Cyclophthalmus senior Corda, Verhandl. Gesellsch. vaterl. Mus. Böhm., 1835, pp. 38–43, pl., figs. 1–14; Fritsch, Fauna Steink. Böhm., 9–14, pl. 1, figs. 1–8, pl. 2, figs. 1–6, 2^c, pl. 3, fig. 4, 1874. *Microlabis Sternbergi* Corda, Verhandl. Gesellsch. vaterl. Mus. Böhm., 1839, pp. 15–18, pl. 1, figs. 1–5. Bohemia.

Fritsch has shown Corda's two species to be but one.

MAZONIA Meek and Worthen.

Mazonia Woodiana Meek and Worthen, Geol. Surv. Ill., iii. 563–565, figs. A–D, 1868. Mazon Creek, Ill.

Other paleozoic scorpions have been found in Permian strata at Nyřan, Bohemia (Fritsch, Fauna Gaskohle Böhm., i. 32, 1879), and in carboniferous stumps at the Joggins, Nova Scotia (Scudder, Phil. Trans. 1882, p. 650). Additional specimens in my hands from Mazon Creek have not been studied.

ORDER ARANEÆ.

SUBORDER TERRITELARIÆ THORELL.

Fam. LIPHISTIOIDÆ Thorell.

PROTOLYCOSA Roemer.

Protolycosa anthracophila Roemer, Neues Jahrb. Miner., 1866, pp. 136–141, pl. 3, figs. 1–3. Thorell, Eur. Spiders, 221, 222, 1870. Kattonitz, Upper Silesia.

PALARANEA Fritsch.

Palaranea borassifolia Fritsch, Fauna Steink. Böhm. 8, pl. 2, fig. 7, 1874. Bohemia.